AMENDMENT TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS

1 – 120 (cancelled)

121. (new) A method of training a model pattern for use in geometric pattern matching, the method comprising:

obtaining a digital image of an object;

detecting boundary points in the digital image so as to form a pattern boundary; and

producing a plurality of displacement vectors, each displacement vector pointing to a nearest point along the pattern boundary.

122. (new) The method of claim 121, wherein each displacement vector is stored at a grid element of an array of grid elements.

123. (new) The method of claim 122, wherein producing a plurality of displacement vectors includes:

producing a displacement vector at a grid element using a displacement vector from a neighboring grid element.

124. (new) The method of claim 123, wherein producing a displacement vector at a grid element using a displacement vector from a neighboring grid element includes:

constructing a first vector from the center of the grid element, to the center of the neighboring grid element;

constructing a projection of the first vector, onto the displacement vector from the neighboring grid element; and

constructing the displacement vector at the grid element by adding the displacement vector from the neighboring grid element, to the projection of the first vector onto the displacement vector from the neighboring grid element.

125. (new) The method of claim 124, further including,

computing an offset value having:

a length equal to the length of the difference between the displacement vector at a grid element, and the projection of the first vector onto the displacement vector from the neighboring grid element; and

a sign that is determined by the direction in which the first vector must be rotated to coincide with the projection of the first vector.

126. (new) The method of claim 125, wherein counter-clockwise rotation is deemed to result in a positive sign.

127. (new) The method of claim 123, wherein the neighboring grid element is a diagonal neighbor.

128. (new) The method of claim 123, wherein the neighboring grid element is a neighbor that shares a side of the neighboring grid element.

129. (new) The method of claim 123, wherein producing a displacement vector at a grid element using a displacement vector from a neighboring grid element includes:

producing a displacement vector at the grid element that is parallel to the displacement vector from the neighboring grid element.

130. (new) The method of claim 123, wherein producing a displacement vector at a grid element using a displacement vector from a neighboring grid element includes:

producing a displacement vector at the grid element that is parallel to the displacement vector from the neighboring grid element, and that extends from the center of the grid element to the nearest point along the pattern boundary.

131. (new) The method of claim 122, wherein producing a plurality of displacement vectors occurs over a sequence of propagation events, each propagation event providing additional displacement vectors at respective additional grid elements.

132. (new) The method of claim 131, wherein grid elements are initialized to a pre-defined value before the sequence of propagation events.

133. (new) The method of claim 132, wherein the pre-defined value is one of: a value independent of any boundary point, and a value dependent on at least one boundary point.

134. (new) The method of claim 132, wherein the pre-defined value is "expect blank".

135. (new) The method of claim 131, wherein each propagation event includes:

for each grid element considered for propagation of a displacement vector to the grid element, all neighbors of the grid element are examined such that, if at least two adjacent neighbors have valid displacement vectors, a displacement vector will be propagated to the grid element during that propagation event, else, a displacement vector will not be propagated to the grid element during that propagation event.

136. (new) The method of claim 135, wherein for each adjacent neighbor of the grid element having a valid displacement vector, a new displacement vector originating at the grid element, and an associated offset, is computed such that the new displacement vector is parallel to the valid displacement vector, resulting in a plurality of new displacement vectors originating at the grid element, and a plurality of associated offsets.

137. (new) The method of claim 136, wherein a propagated displacement vector is computed by interpolating between two of the plurality of new displacement vectors.

138. (new) The method of claim 136, wherein the two of the plurality of new displacement vectors are selected using the plurality of associated offsets.

139. (new) The method of claim 138, wherein adjacent neighbors are sequentially scanned to detect a single positive-to-negative transition between adjacent neighbors, the single positive-to-negative transition being used to select the two of the plurality of new displacement vectors.

140. (new) The method of claim 139, wherein adjacent neighbors are scanned counter-clockwise in sequence.

141. (new) The method of claim 137, wherein interpolating between two of the plurality of new displacement vectors includes:

computing a weighted average of the two of the plurality of new displacement vectors.

142. (new) The method of claim 141, wherein computing a weighted average of the two of the plurality of new displacement vectors includes:

weighting of each of the two new displacement vectors using the magnitude of the offset of the other of the two new displacement vectors.

143. (new) The method of claim 141, wherein computing a weighted average of the two of the plurality of new displacement vectors includes:

scaling each new displacement vector by its corresponding weight, adding the results, and then scaling by the inverse of the sum of the weights.

144. (new) The method of claim 141, wherein computing a weighted average of the two of the plurality of new displacement vectors includes:

performing an independent weighted average of the x and y components of the two of the plurality of new displacement vectors.

145. (new) The method of claim 141, wherein computing a weighted average of the two of the plurality of new displacement vectors includes:

performing an independent weighted average of the magnitude and direction of the two of the plurality of new displacement vectors.

146. (new) The method of claim 137, wherein if the two of the plurality of new displacement vectors are pointing to distant points along a pattern boundary, or are pointing to different boundaries, the grid element is not assigned a propagated displacement vector, instead being assigned a "don't care" code.

147. (new) The method of claim 146, wherein the two of the plurality of new displacement vectors are pointing to distant points along a pattern boundary if their magnitudes differ by more than 3 grid units.

148. (new) The method of claim 146, wherein the two of the plurality of new displacement vectors are pointing to distant points along a pattern boundary if their directions differ by more than 135 degrees.

149. (new) The method of claim 146, wherein the two of the plurality of new displacement vectors are pointing to different boundaries if their magnitudes differ by more than 3 grid units.

150. (new) The method of claim 146, wherein the two of the plurality of new displacement vectors are pointing to different boundaries if their directions differ by more than 135 degrees.

151. (new) The method of claim 131, wherein each propagation event includes:

for each adjacent neighbor of the grid element having a valid displacement vector, computing a new displacement vector originating at the grid element, and computing an associated offset; and

for each grid element considered for propagation of a displacement vector to the grid element, if a neighboring grid element with a valid displacement vector is associated with a small positive offset, and if no counter-clockwise adjacent neighbor has a valid displacement vector, propagating a displacement vector to the grid element during that propagation event using the new displacement vector without interpolation.

152. (new) The method of claim 131, wherein each propagation event includes:

for each adjacent neighbor of the grid element having a valid displacement vector, computing a new displacement vector originating at the grid element, and computing an associated offset; and

for each grid element considered for propagation of a displacement vector to the grid element, if a neighboring grid element with a valid displacement vector is associated with a small negative offset, and if no clockwise adjacent neighbor has a valid displacement vector, propagating a displacement vector to the grid element during that propagation event using the new displacement vector without interpolation.

153. (new) The method of claim 151, wherein a small negative offset is an offset of magnitude less than 1/10 of a grid element.

154. (new) The method of claim 152, wherein a small positive offset is an offset of magnitude less than 1/10 of a grid element.

155. (new) The method of claim 131, wherein there are four propagation events.

156. (new) The method of claim 131, wherein the number of propagation events is determined by a user-settable parameter.

157. (new) The method of claim 131, wherein each propagation event provides a plurality of displacement vectors, each displacement vector indicating a distance and direction toward the pattern boundary.

158. (new) The method of claim 131, wherein each propagation event provides a plurality of displacement vectors that are disposed at a greater distance from the pattern boundary than the plurality of displacement vectors provided by a previous propagation event.

159. (new) The method of claim 121, wherein producing a plurality of displacement vectors results in a vector-valued function of position within a region of the image that includes the pattern boundary.

160. (new) The method of claim 159, wherein the vector-valued function relates a plurality of at least two-dimensional positions to a plurality of respective displacement vectors.

161. (new) The method of claim 159, wherein each displacement vector indicates a distance and direction from a two-dimensional position to a nearest point along the pattern boundary.

162. (new) The method of claim 159, wherein the vector-valued function relates a plurality of two-dimensional positions and associated directions to a plurality of respective displacement vectors.